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Applicant: Osaka Fuji Industries Co., Ltd.

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SPECIFICATION

[Title of the Invention]

Device for actuating flush valve of toilet

[ABSTRACT]

[Object] To provide an actuating device for a flush valve, which can be added to an existing toilet utilizing a manual flush valve to convert it into an automatic flushing type and in which, if automatic flushing does not function due to malfunction or the like, the manual valve opening mode can be adopted.

[Constitution]

A human body detection sensor 26, a cam driving motor 18 and a containing portion 29 for batteries 28 are provided in an adapter case 4 attached to the outside of a flush valve 2. A push rod 13 for laterally pressing a valve shaft 20 of the valve 2 to open the valve is normally positioned, by a biasing force of a spring member 17, so that the rear end of the rod is separated from the valve shaft 20. A rotary cam plate 19 for pushing and driving the push rod 13 upon actuation is

mounted on a rotary shaft of the motor 18, and a connecting member 22 for connecting a push button 5 provided on a front face of the adapter case 4 to an outer end portion of the push rod 13 is positioned to bypass the rotary cam plate 19.

[Claims]

1. A device for actuating a flush valve of a toilet, wherein: an adapter case is provided to be positioned outside said flush valve of said toilet, and a push rod for laterally pushing a valve shaft of said valve to open said valve has a front end portion protruding into said adapter case and normally biased forwardly by a spring member so that a rear end is separated from said valve shaft; within said adapter case, there are provided a human body detection sensor, a cam driving motor operated on the basis of a detection signal, and a containing portion for containing a battery as a power source for said sensor and said motor; a push button is provided at a front face of said adapter case; a rotary cam plate for driving said push rod rearwardly upon actuation is secured to a rotary shaft of said motor; and a connecting member for connecting said front end of said push rod to said push button while bypassing said rotary cam plate is provided.

2. A device for actuating a flush valve of a toilet according to claim 1, wherein a reset switch for returning said cam driving motor to an inoperative position of said rotary cam plate is provided in said adapter case; said connecting member is provided with a contact portion which engages with said switch upon depression of said push button to turn said switch ON; said connecting member is designed so

that it engages an outer end portion of said push rod only in a press-driving direction of said rod; and a spring member is provided to bias said connecting member toward an outer protruded side of said push button.

[Brief Description of the Drawings]

Fig. 1 is a perspective view of a urinal to which an actuating device for a flush valve according to an embodiment of the present invention is attached;

Fig. 2 is a longitudinal sectional view of the actuating device;

Fig. 3 is a cross-sectional view of the actuating device;

Fig. 4 is an enlarged longitudinal sectional side view showing main parts of the actuating device;

Fig. 5 is a longitudinal sectional side view showing main parts and illustrating an automatic flushing operation of the actuating device; and

Fig. 6 is a longitudinal sectional side view showing main parts, illustrating a manual flushing operation of the actuating device.

[Explanation of Reference Numerals]

- 1      urinal
- 2      flush valve
- 3      actuating device
- 4      adapter case
- 5      push button
- 13     push rod
- 13a   front end portion
- 13b   rear end portion

- 17 coil spring (spring member)
- 18 cam driving motor
- 18a rotary shaft
- 19 rotary cam plate
- 20 valve shaft
- 22 connecting member
- 22d projection (contact portion)
- 23 coil spring (spring member)
- 26 human body detection sensor
- 27 reset switch
- 28 battery
- 29 containing portion

## [Detailed Description of the Invention]

### [Field of the Invention]

The present invention relates to a device for actuating a flush valve attached to a toilet to flush the same, and more particularly, it relates to such an actuating device that can be added to an existing flush valve of manual push button type to convert it into an automatic flushing type.

### [Prior Art]

In the past, as means for supplying a predetermined amount of flushing water to a flushing toilet, flush valves have already been used. An automatic flush valve for the flushing toilet in which a figure of a user is optically detected by a sensor to automatically open the valve has come to be mainly used in newly-installed toilets, since it has advantages that it is more sanitary, in comparison with the conventional manual flush valve in which a user must manually depress an actuation button, because the user does not need to touch the device and the flushing can surely be performed regardless of missing depression of the button unlike the case of the manual operation.

However, many toilets utilizing the manual flush valve have actually already been installed. When such toilets are changed to the automatic flushing types, significant cost is incurred for elements of new equipment and for piping and other working. Furthermore, it is wasteful that existing components still having sufficient endurance must be discarded.

In consid ration of the above, there has been proposed a device in which a particular automatic valve opening mechanism having the above-mentioned sensor is added to the existing toilet utilizing the manual flush valve to provide an automatic mode (Utility Model Publication No. Hei 3-10223). The proposed device is designed so that a pressing rod is positioned in front of an actuation button of a manual flush valve so that the rod is pivotally mounted at its one end in such a manner that an intermediate portion of the rod contacts with the actuation button and the other end of the pressing rod is link-connected to a cylindrical cam rotatably driven by a motor, and, the motor is driven in response to a detection signal from a human body detection sensor, with the result that the pressing rod is swung about the one end by rotation of the cylindrical cam, thereby depressing the actuation button.

[Problem to be Solved by the Invention]

However, in the above-mentioned proposed device, since the actuation button is placed in the automatic operating mode provided by the operation of the pressing rod, the manual operation cannot be effected when interruption of electric power or malfunction of the sensor occurs, with the result that the flushing cannot be achieved, thereby contaminating the toilet. Further, there are such shortcomings that it is required to provide exclusive electrical wiring in a lavatory in order to maintain or reserve an operating power source, and the operation for wiring is time-consuming.

In consideration of the above, an object of the present invention is to provide an actuating device for a flush valve of a toilet, which can be added to an existing toilet utilizing a manual flush valve to convert it into an automatic flushing type and in which provision of the device can easily be performed without effecting working of electrical wiring and, eve when the automatic flushing does not function due to malfunction or the like, the manual valve opening operation can be effected without any trouble.

[Means for Solving Problem]

To achieve the above object, a flush valve actuating device according to the present invention is characterized in that an adapter case is attached to surround the flush valve of a toilet, and a push rod for laterally pressing a valve shaft of the valve to open the valve has a front end protruding into the adapter case and is normally biased forwardly by a spring member so that a rear end of the push rod is separated from the valve shaft; within the adapter case, there are provided a human body detection sensor, a cam driving motor operated on the basis of a detection signal, and a containing portion for containing a battery as a power source for the sensor and the motor; a push button is provided at a front face of the adapter case; a rotary cam plate for driving the push rod rearwardly upon actuation is secured to a rotary shaft of the motor; and a connecting member for connecting the front end of the push rod to the push button while bypassing the rotary cam plate is provided.



Further, according to the present invention, in the above-mentioned actuating device, a reset switch for returning the cam driving motor to an inoperative position of the rotary cam plate is provided in the adapter case; the connecting member is provided with a contact portion which engages with the switch upon depression of the push button to turn the switch ON; the connecting member is designed so that it engages an outer end portion of the push rod only in a press-driving direction of the rod; and a spring member is provided to bias the connecting member toward an outer protruded side of the push button.

#### [Operation]

When a toilet is not being used, the rotary cam plate is set to be positioned in a rotation position where the cam plate does not press the push rod, with the result that the push rod is held in the outwardly protruded condition where the rear end thereof does not contact with the valve shaft of the flush valve thereby to close the flush valve. When a user is detected by the human body detection sensor, the cam driving motor is driven to rotate the rotary cam plate in response to the detection signal, with the result that the push rod is driven to press the valve shaft of the flush valve laterally to cause inclination displacement of the valve shaft, thereby opening the flush valve. When the rotary cam plate is rotated by one revolution to be returned to the original position, the motor is stopped and the push rod is restored to the original protruded condition due to the effect of the spring member; however, the flush valve is maintained

in the opened condition until a predetermined amount of water is supplied by an existing conventional mechanism and then closed.

On the other hand, although the actuating device uses a battery provided in the adapter case as a power source, if the sensor and/or the cam driving motor become inoperable due to consumption of the battery, malfunction or other causes, the originally provided manual flushing can be effected by using the push button provided on the front face of the adapter case. That is to say, when the push button is depressed by the user using his finger, since the push rod is pushed via the connecting member, the flush valve is opened as is the case previously described, thereby supplying the predetermined amount of water to the toilet. When the finger is released from the push button, the push rod is restored to the protruded condition or posture by a biasing force of the spring member while pushing back the connecting member, with the result that the push button is also returned to the protruded posture.

Incidentally, a reset switch for returning the cam driving motor to an inoperative position of the rotary cam plate is attached in the adapter case, and the connecting member is provided with a contact portion which engages with the switch upon depression of the push button to turn the switch ON. In such an arrangement where the connecting member engages the push rod only in the press-driving direction and the connecting member is biased by the spring member toward the protruded condition of the push button, a reset operation

for returning the rotary cam plate to the original rest position can be effected only by depressing the push button after the battery is replaced or maintenance and/or repair is performed.

[Embodiment]

In Figs. 1 to 4, a urinal 1 is provided at its upper part with a manual flush valve 2, and an adapter case 4 of an actuating device 3 according to the present invention is provided to cover the flush valve 2. The adapter case 4 comprises a substantially U-shaped (in a plan view) case body 4a positioned to surround a front side and both left and right lateral sides of the flush valve 2, and a substantially

rectangular (in a plan view) lid member 4b fitted onto the case body to cover an upper side of the flush valve. On a front face of the adapter case, there are provided a manual operation push button 5 protruded at a central portion, and a sensor window 6 positioned in the right of the push button. Incidentally, reference numeral 7 denotes a double bent

positioning plate secured to a bottom surface of the adapter case 4, and a notch 7a formed in the lower bent portion of the positioning plate is engaged by a water discharging pipe 8a connected to the toilet 1, thereby preventing inclination of the case 4. Further, reference numeral 9 denotes a water control valve provided in a water introducing pipe 8b

connected to the flush valve 2.

A push button accommodating cylinder 2b having a forward opening is provided at a lower part of a valve case 2a of the flush valve 2, and a valve shaft 20 is disposed vertically in

the cylinder 2a in a valve-closed condition, so that the flush valve is opened by inclination displacement of the valve shaft 20 to supply a predetermined amount of water to the urinal 1. Conventional manual push button and seal holder which were mounted in the cylinder 2a have been removed, and, in place of them, a cylindrical rod holder 10 is inserted with a peripheral flange portion 10a engaging with an open edge of the cylinder 2a via a gasket 11, and a push rod 13 holding a diaphragm 12 is inserted into the rod holder 10 in coaxial relationship with the latter, and a hold-down ring 14 for pinching a peripheral portion of the diaphragm 12 between this ring and the flange portion 10a is disposed outside of the rod holder 10. Securing nut 15a fitted on the hold-down ring 14 is securely screwed to the cylinder 2a. In the adapter case 4, a rear plate portion 16a of a substantially upwardly opened (in a side view) U-shaped attachment frame 16 is secured to a central inner surface of the case body 4a by a screw, and, by securely screwing an attachment nut 15b onto an outer peripheral threaded portion of the hold-down ring 14 with the rear plate portion 16a disposed therebetween, the attachment frame is securely supported by the valve case 2a of the flush valve 2.

The push rod 13 has a large diameter portion 13c contiguous to a front end portion 13a of the rod and having such a length that the front end portion 13a extends in the adapter case 4 and a rear end portion 13b extends in the valve case 2a. The push rod is biased forwardly (i.e., toward the adapter case 4) by a coil spring 17 loaded in the rod holder

10 so that the rear end portion 13b is normally separated from the valve shaft 20 of the flush valve 2 but is adjacent to the same and is set to laterally press the valve shaft 20 to cause inclination displacement of the shaft when the push rod is driven in opposition to a biasing force of the coil spring 17. The interior of the valve case 2a is completely partitioned from the interior of the adapter case 4 by the diaphragm 12, thereby preventing the water from leaking from the valve case 2a to the interior of the adapter case 4.

A cam driving motor 18 is mounted in the adapter case 4, and a disk-shaped rotary cam plate 19 is eccentrically secured to a rotary shaft 18a of the motor, and the rotary cam plate 19 is inserted in a rectangular frame-shaped slider 21 rested on the attachment frame 16 for only up-and-down relative movement, with front and rear sides being virtually contacted with the slider. Further, the slider 21 has a guide shaft 21a protruded forwardly, and the guide shaft 21a extends through a front plate portion 16b of the attachment frame 16 to extend into the interior of the push button 5 so that the slider is slid on the attachment frame 16 in a front-and-rear direction by eccentric rotation of the rotary cam plate 19 caused by driving the motor 18. The guide shaft 21a of the slider 21 and the push rod 13 are arranged on the same axis, and it is set so that the front end portion of the push rod 13 normally abuts against a rear end surface of the slider 21 and the rear end portion 13b of the push rod 13 is spaced from the valve shaft 20 of the flush valve 2 at a front limit position of the slider 21.

Reference numeral 22 denotes a box-shaped connecting member opened downwardly and forwardly (i.e., toward the cam driving motor 18), and the connection member is positioned for movement in the front-and-rear direction and to enclose the rotary cam plate 19 and the slider 21 in such a manner that the guide shaft 21a of the slider extends through a front wall portion 22a of the connecting member and the front end portion 13a of the push rod 13 extends through a rear wall portion 22b. The connecting member is biased by a coil spring 23 mounted on the guide shaft 21a between the front wall portion 22a and the slider 21 so that the front wall portion 22a urges an inner end surface of the push button 5. Further, a through-hole 21c formed in the rear wall portion 22b has a diameter smaller than that of the large diameter portion 13c of the push rod 13 so that, when the connecting member is shifted rearwardly, the rear wall portion abuts against the large diameter portion 13c to urge or push the push rod 13. Incidentally, the push button 5 has a substantially U-shape (in a diametrical cross-sectional view) and is held in a protruded posture so that a rear end flange portion 5a normally abuts against an inner surface of the opening edge of the case body 4a via a gasket 25 by a coil spring 24 disposed between an inner surface of a front wall of the button and the front wall portion 22a of the connecting member 22.

On the other hand, as shown in Fig. 3, a human body detection sensor 26 opposed to the sensor window 6 and a reset switch 27 are secured in the adapter case 4, and a containing portion 29 for containing batteries 28 as power sources of th

sensor 26 and the cam driving motor 18 is disposed at the left side, and an electronic circuit substrate 30 is attached at the right side. When the connecting member 22 reaches a rear limit position, a projection 22d of the connecting member engages with a contact member 27a, thereby turning the switch ON.

In the actuating device 3 having the above-mentioned arrangement, in an inoperative condition of the urinal 1, the rotary cam plate 19 is positioned in a rotation position where a largest radius portion is directed forwardly, as shown in Figs. 2 to 4. In this position, the slider 21 and the push rod 13 are both in the front limit position, with the result that the valve shaft 20 is not contacted by the inner end portion 13b of the push rod 13, thereby closing the flush valve 2. When the user is detected by the human body detection sensor 26, the cam driving motor 18 is driven in response to a detection signal to rotate the rotary cam plate 19 by one revolution. In the course that it takes half revolution, as shown in Fig. 5, the slider 21 is shifted rearwardly to press the push rod 13, with the result that the inner end portion 13b of the rod drives the valve shaft 20 laterally, thereby opening the flush valve 2 to supply water to the urinal 1. Then, when the rotation of the rotary cam plate 19 exceeds the half revolution, the slider 21 is switched to the forward movement, with the result that the push rod 3 is shifted forwardly by the accumulated force of the coil spring 17. When the cam plate 19 is rotated by one revolution to return to the original position, the motor 18 is

stopped and the push rod 13 is returned to the original protruded posture. However, the flush valve 2 is maintained in the opened condition until the predetermined amount of water is supplied, and thereafter it is closed. Accordingly, the urinal 1 is automatically water-flushed each time it is used.

Incidentally, although the human body detection sensor 26 is normally set to output the detection signal at a time when the user stands in front of the sensor for a predetermined time period (for example, 4 seconds) or more and then leaves in order to effect the flushing after the urinal 1 was used, the sensor may be set to output the detection signal to start the flushing during the use of the urinal. Further, separately from the flushing which is effected by the sensor 18 each time after the use of the toilet, the cam driving motor may be driven by a timer mechanism each time after a predetermined time is elapsed to effect the flushing.

If the automatic flushing function does not work due to some causes such as consumption of the battery, malfunction or the like, flushing may also take place. When the user pushes the push button 5 in front of the adapter case 4 by his finger, the connecting member 22 is pressed to be shifted rearwardly as shown in Fig. 6, with the result that the push rod 13 is also driven similarly to the automatic mode and the flush valve 2 is opened to supply the predetermined amount of water to the toilet. When the user's finger is released from the push button 5, the push rod 13 is restored to the protruded posture by the accumulated force of the coil spring



23 while pushing back the connecting member 22, with the result that the push button 5 is also returned to the protruded posture. Accordingly, during the time period until the consumed battery is replaced or the malfunction is restored, the urinal 1 can be flushed each time after the use thereof in the same manner as the original manual type, thereby avoiding contamination and insanitation.

As explained above, the connecting member 22 is shifted rearwardly when the push button 5 is depressed. Upon this shifting movement, the projection 22d of the connecting member 22 pushes the contact member 29a of the reset switch 27 to turn the latter ON. Accordingly, after the battery is replaced or the maintenance and/or the repair is effected, a resetting operation for returning the rotary cam plate to the original rest position can be performed only by depressing the push button 5, and, thus, unlike the conventional techniques, it is not required to open the lid 4b.

Incidentally, in the above-mentioned embodiment, while an example that the rotary cam plate 19 urges the push rod 13 via the slider 21 is explained, it is possible to modify it so that the periphery of the rotary cam plate 19 directly contacts the front end of the push rod 13. Further, although it is intended in the above-mentioned embodiment that the existing manual push button and seal holder in the flush valve 2 are removed and the actuating device 3 according to the present invention is attached, such push button and seal holder may be used (as they are) as the push rod and the rod holder. Further, in the actuating device for the flush valve

of the toilet according to the present invention, regarding detailed construction such as configurations and arrangements of various elements, various design modifications can be made other than the above-mentioned embodiment, and the present invention can be applied to a stool bowl, other than the urinal.

[Effect of the Invention]

According to the actuating device for the flush valve of the toilet of the present invention, only by adding the actuating device to an existing toilet utilizing a manual flush valve, the toilet can be converted to the automatic flushing type, and, since the battery is used as the operation power source, the attaching of the actuating device can easily be performed without any electric wiring working, and the automization can be achieved with very low cost. Furthermore, if the automatic flushing does not work due to consumption of the battery or malfunction, the manual flushing can be effected by operation of the push button in a way similar to the original manual mode, thereby avoiding contamination and insanitation during the time period when the consumed battery is replaced or the malfunction is restored.

Further, according to the arrangement in claim 2, when the resetting operation for returning the rotary cam plate to the original rest position is to be effected after the battery is replaced or the maintenance and/or the repair is performed, it is not required to open the lid of the adapter case, and the reset can be effected easily only by depressing the push button.